STATE OF CALIFORNIA
CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD
CENTRAL COAST REGION

STAFF REPORT FOR REGULAR MEETING OF OCTOBER 24, 2003
Prepared on October 3, 2003

ITEM NUMBER: 15

SUBJECT: Perchlorate Sites

DISCUSSION:

Background

Perchlorate is both a naturally occurring and man-made chemical, although it is rarely found naturally in the United States. One-third of all perchlorate used in the United States is used in California and 90% of California's perchlorate use is related to the aerospace industry. There are three major sources of perchlorate in the United States: ammonium perchlorate has been and continues to be used as an oxidizer in solid rocket propellant, sodium perchlorate is used in slurry explosives, and potassium perchlorate is used in road flares and air bag inflation systems. Wastes from the manufacture and improper disposal of perchlorate-containing chemicals are increasingly being discovered in soil and water.

Health Effects

Perchlorate is known to interfere with the natural function of the thyroid gland by inhibiting the uptake of iodide. Because iodide is an essential component of thyroid hormones, perchlorate disrupts how the thyroid functions. Such an effect decreases production of thyroid hormones, which are needed for prenatal and postnatal growth and development, as well as for normal body metabolism. Potassium perchlorate was used until recently to treat hyperthyroidism related to Grave's disease, and is still used diagnostically to test thyroid hormone production in some clinical settings.

Regulatory Standards

Currently there is no state or federal drinking water maximum contaminant level (MCL) for perchlorate. Both the U.S. Environmental Protection Agency (EPA) and the California Department of Health Services (DHS) are in the process of studying the occurrence and health effects of perchlorate. California is mandated by SB 1822 to develop a drinking water standard for perchlorate by January 1, 2004. Until an MCL is in place, DHS uses a 4 microgram per liter (µg/L) advisory action level to protect consumers from perchlorate's adverse health effects. An action level is an advisory level and is not an enforceable standard. When it is exceeded, a water purveyor is required to notify local governing agencies and is recommended to issue a consumer notice. In addition, DHS recommends that a source of drinking water be taken out of service if perchlorate contamination exceeds 40 µg/L.

Treatment Methods

Treatment of perchlorate contamination in water is complicated because the perchlorate anion does not respond to typical water treatment techniques due to its fundamental physical and chemical nature. The perchlorate tetrahedron itself is structured such that the four oxygen atoms surround the central chlorine atom, effectively blocking reductants from directly attacking the chlorine. Although perchlorate is thermodynamically a strong oxidizing agent, it is a kinetically sluggish species, making its reduction generally very slow and rendering common reductants ineffective. It can persist in the environment

for many decades under typical groundwater and surface water conditions because of its resistance to react with other available constituents.

Perchlorate treatment technologies may be generally classified into categories of destruction or removal technologies. Destructive processes include biological reduction, chemical reduction, and electrochemical reduction. Physical removal processes include anion exchange, membrane filtration (including reverse osmosis and nanofiltration), and electrodialysis, which all require subsequent disposal of removed perchlorate. The optimum treatment technology for a given perchlorate occurrence may depend on several factors, including perchlorate concentration, the presence and concentration of co-contaminants, other water quality parameters and geochemical parameters. The presence of indigenous perchlorate-reducing microbes and substances inhibitory to their activity will also influence perchlorate treatment technology effectiveness. For in-situ treatment of perchlorate contamination, variables related to the site hydrogeologic setting, such as depth to and distribution of contaminants, soil permeability, groundwater flow velocity, etc. are also additionally important.

Updates on significant perchlorate sites within the region follow.

Olin Corporation Facility, 425 Tennant Avenue, Morgan Hill, Santa Clara County [John Mijares 805-549-3696]

The former Olin Corporation site is a 13-acre parcel located in southern Morgan Hill. Olin manufactured signal flares at the facility for about 32 years from 1956 to 1988. Standard Fusee leased the site and manufactured signal flares for seven years from 1988 to 1995. Potassium perchlorate was used in the manufacture of flares by both Olin and Standard Fusee. Perchlorate contamination at the site may have come from an unlined evaporation pond that received wastes from the cleaning of the ignition material mixing bowls, on-site incineration of cardboard flare coatings with residues on them, and accidental spills. The Regional Board never regulated waste disposal practices while the facility operated, but facility records do make reference to inspections by Board staff.

Groundwater in the region typically occurs in alluvial sediments, at depths ranging from 7 to 400 feet below ground surface. The alluvial deposits are composed of heterogeneous layers of clay, silt, sand, and gravel. Interconnected multiple aquifers exists within the area. Groundwater underneath the site is generally unconfined, although there are identified confined zones within the sub-basin to the southeast of the property.

Perchlorate was first detected at the site in August 2000 during a due diligence investigation by a potential buyer. Perchlorate was detected at 21 and 55 μg/L in water samples from two borings advanced in the general area of the former flare production building. The DHS action level for perchlorate at the time was 18 μg/L. To verify the perchlorate detections, three monitoring wells (MW-1, MW-2, and MW-3) were installed and sampled in October 2000. Perchlorate was detected at 17 μg/L in MW-1, 37 μg/L in MW-2, and was not detected above 4 μg/L in MW-3.

In response to the perchlorate detections, Olin directed its consultant to verify perchlorate detections reported by the potential buyer. Results of the samples collected in December 2000 show that perchlorate was detected at 15 μg/L in MW-1, 25 μg/L in MW-2, and 4.2 μg/L in MW-3.

Olin made initial contact with Board staff regarding the perchlorate contamination in February 2001. Board staff required Olin to submit previous investigation reports for the site and required additional testing of the onsite monitoring wells and the City of Morgan Hill Tennant Avenue well.

In December 2001 Board staff issued Monitoring and Reporting Program No. 01-161 requiring quarterly monitoring of the onsite monitoring well and the City's Tennant Avenue well.

In January 2002, DHS lowered the action level of perchlorate from 18 to 4 µg/L in response to the release of the United States Environmental Protection Agency's External Draft Review Reference Dose for perchlorate of 0.00003 mg/kg/day. This translates into a drinking water concentration of approximately 1 µg/L.

As required by the Board, in March 2002 Olin conducted a soil and groundwater investigation at potential source areas to further assess the source and extent of perchlorate, lead, and chromium. Results of the investigation indicated that lead was not a chemical of concern and additional investigation indicated that chromium and hexavalent chromium were not constituents of concern. Perchlorate was detected in several shallow soil samples located on the perimeter of the former building 5 and the former hazardous material storage areas. Results of the soil analysis indicate that the extent of perchlorate near portions of these two areas was still not completely characterized. In groundwater, perchlorate was detected up to a maximum of 167 µg/L in water samples collected from five CPT borings advanced to a depth of 200 feet below ground surface. The lateral and vertical migration pathways of perchlorate was unclear and required additional investigation.

To follow up on the March 2002 investigation, Olin conducted a Phase 2 soil and groundwater investigation to further determine the extent of perchlorate contamination and fill data gaps. The Phase 2 investigation initially included the sampling of downgradient offsite domestic wells (Tier 1 wells) within one half mile of the site to assess offsite perchlorate migration. Of the 27 domestic water supply wells sampled, perchlorate was detected in four wells at concentrations ranging from 9.5 to 98.4 µg/L. Olin informed the well owners and tenants of the perchlorate detections, advised them not to drink or cook with the water, and supplied them with bottled drinking water. The Board directed Olin to immediately expand the sampling area to include domestic wells located between one-half mile and one mile of the Olin site (Tier 2 wells). Olin submitted in December 2002 results of the Phase 2 soil and groundwater investigation.

On January 16, 2003, Santa Clara Valley Water District (District) hosted a press conference, with participation of Regional Board staff, to announce results of the offsite domestic well sampling and to answer questions. The District also announced they would sample private wells, if requested, for perchlorate in the potentially contaminated area. The District provided bottled drinking water to residents who requested it until their wells were tested. The original area of potential perchlorate groundwater contamination was south of Tennant Avenue, north of Masten Avenue, east of Monterey Road, and west of Center Avenue (see Attachment 1).

Since perchlorate was detected outside of the original study area, the Board directed Olin to expand the area of investigation to determine the lateral and vertical extent of perchlorate contamination in groundwater. Perchlorate was detected above the action in numerous domestic and agricultural wells including the water supply wells operated by the West San Martin Water Works (250-plus connections) and the San Martin County Water District (200-plus connections).

On June 30, 2003, Olin submitted the Phase 3 Soil and Groundwater Investigation Report. The purpose of the Phase 3 investigation was to gather information to fill data gaps identified in previous investigations, characterize the site's geology and hydrogeology, define the extent of soil and groundwater perchlorate contamination, and determine the hydraulic properties of the affected aquifers to predict perchlorate fate and transport design remedial measures. Since the submittal of the Report, Regional Board, Santa Clara Valley Water District, Olin and its consultants have discussed the Report.

Perchlorate Community Advisory Group meetings are held monthly in San Martin. The advisory group is a forum for public discussion of the perchlorate problem and potential solutions. Regional Board staff will solicit advisory group input at key decision points in the investigation and cleanup process.

As of July 3, 2003, the District has plotted results (Attachment 1) of 1,169 samples collected by the District and Olin. The number of wells is slightly smaller than the number of samples collected because some wells serving multiple connections have samples collected from each connection. Results are broken down as follows:

- *Non-detect (< 4 μg/L) – 784 samples*
- *4-9.9 μg/L – 429 samples*
- *10-19.9 μg/L – 10 samples*
- 20-39.9 *μg/L* – 2 samples
- *40-100 μg/L – 3 samples*

City of Morgan Hill Municipal Wells *– Fourteen of the fifteen City's municipal wells were tested for perchlorate in August 2003. Perchlorate was not detected in any wells except for the Condit well, which had a detection of 4 μg/L. Condit is still offline because of this detection. Nordstrom well has been on line since August 2, 2003, after installation of a wellhead treatment for the removal of perchlorate. Dunne 2 is on standby and used on an intermittent basis and no perchlorate has been detected since March 18, 2003. Condit, Dunne, and Nordstrom wells are located northeast of the Olin site and had previous detections of perchlorate at or above 4 μg/L. The Tennant Avenue well is still offline pending completion of the ion exchange wellhead treatment. Perchlorate has not been detected at the Tennant Avenue well during the 2nd quarter and since the 1st quarter of 2002 when well operation was discontinued.*

Olin installed wellhead ion exchange perchlorate removal systems at two supply wells of the West San Martin Water Works. The wells became operational during the first week of September 2003, producing about 600 gallons per minute, and serving about 250 homes and several county office buildings. The wells will remove perchlorate from groundwater and supply perchlorate-free water to West San Martin Water Works customers. Successful operation of the perchlorate removal system will eliminate the need for bottled water.

On August 7, 2003, the Board revised Monitoring and Reporting Program No. 2001-161. The monitoring program requires quarterly monitoring of all onsite wells, the Tennant Avenue well, 42 offsite wells and all offsite domestic, agricultural or municipal wells with detections between 2 and 4 μg/L perchlorate. Olin has already implemented these monitoring requirements during the second quarter (Apr-Jun) 2003 monitoring.

Olin sampled a total of 262 Tier 4 wells (five mile plus downgradient of the Olin site) during the first and second quarters of 2003. Ninety-six of the 262 wells have perchlorate concentrations greater than 4 μg/L, within the range of 4 to 9.03 μg/L. Perchlorate was not detected in the remaining 166 wells.

Eighty additional wells were added to the Tier 4 wells located to the east, west, and south of the previous sampling location to determine the extent of the perchlorate plume. Ten of the 80 wells have perchlorate concentrations of at least 4 μg/L, in the range of 4 to 6.4 μg/L. Perchlorate was not detected above 4μg/L in 70 of the wells sampled.

Thirty-four of 42 wells specified in the monitoring program were sampled during the second quarter of 2003 (8 were unavailable for sampling). Ten of the 34 wells sampled have perchlorate concentrations of at least 4 μg/L, with a range of 4 to 100 μg/L. Perchlorate was not detected in the other 24 wells sampled.

Seventy-four of 113 wells with perchlorate concentrations between 2 to 4 μg/L were sampled during the second quarter of 2003. Forty-six of 74 wells have perchlorate concentrations of at least 4 μg/L, in the range of 4 to 99 μg/L. Perchlorate was not detected in the remaining 28 wells.

On August 12, 2003, Olin submitted two reports. Development of Screening Levels for Perchlorate in Soil presents calculations of a perchlorate concentration that Olin contends could remain in soil at the site without further impacts to groundwater quality, human health, or the environment. Initial Design for Combined Full-Scale Remediation of

Perchlorate-Impacted Soil & On-Site Groundwater presents a preliminary plan to remediate soil and groundwater at the Olin site through extraction of groundwater from two wells, on-site treatment of the extracted groundwater using ion exchange resin, off-site disposal of some portion of the treated water, and re-application of some portion of the treated water to ground surface at the site to flush perchlorate from the vadose zone. On September 30, Board staff sent written comments (Attachment 2) to Olin on these two reports and required Olin to submit the following:

October 24, 2003 – *Report on extraction well installation and hydraulic testing;*

November 21, 2003 *– Remedial alternative analysis; and*

December 31, 2003 – *Notification that the groundwater extraction and treatment system is operating.*

On September 30, 2003, the Board sent a letter (Attachment 3) requiring Olin to submit a plan by October 10, 2003, for determining if detections of perchlorate found in wells between Olin's site and Morgan Hill's Nordstrom Park well are related to Olin's perchlorate releases at its site.

On September 5, 2003, the Board sent a letter requiring Olin to identify and sample wells downgradient of the most recent southerly detection of perchlorate to determine the southerly extent of the perchlorate plume. (Attachment 4) In addition, Olin is further required to submit a proposal for determining the vertical distribution of perchlorate in the groundwater basin. The sampling results and the proposal are required to be submitted by October 30, 2003.

On September 19, 2003, Olin submitted a 45% design report for on-site cleanup.

Response to comments and requests made at the September 12, 2003 Board Meeting

1. Include cities in technical discussions

Response *– We agree that participation of all agencies in technical discussions with Olin would be beneficial. Staff will continue to work toward this and is willing to facilitate such meetings. Regular technical discussions among the agencies continue.*

2. Require Olin to cooperate with Tennant Ave wellhead treatment costs

Response *– As discussed at the Board meeting, the Board cannot require Olin to reimburse the city for its costs or to implement any particular treatment or cleanup method. We are willing to facilitate discussions. SB 1004 (not yet signed by the governor) clarifies existing law regarding the authority of regional boards to order polluters to provide water to replace any that is contaminated. Morgan Hill's attorney offered to provide her analysis of a regional board's authority in emergency situations.*

3. Require Olin to develop a contingency plan in case a Gilroy well is affected by perchlorate

4. Require Olin to develop cleanup and replacement water plans for unincorporated areas

5. Begin basin-wide cleanup of groundwater now, perhaps by providing well head treatment for all affected wells, which will begin to clean up the basin and prevent further spread toward Gilroy. Put ion exchange on all San Martin Wells. Need an aggressive plan and schedule. What is the time table? What funding could be allocated? How can SCVWD help with their resources?

Response *– Staff is drafting new requirements for Olin, either in the form of a cleanup or abatement order or as a Water Code 13267 information request, which will address these issues. Olin will be responsible for funding and implementing the cleanup. Because the Board cannot require any particular type of cleanup system, Olin will be required to study the various alternatives and propose a replacement water solution.*

5. Define the plume to the south, west, and vertically

6. Install sentry wells in Gilroy area to alert the city of imminent pollution

7. Install a line of wells (nested, multi-level wells) the length of the valley to determine the vertical extent of perchlorate

Response *– The Board's September 5, 2003 letter requires Olin to evaluate data collected through third quarter 2003. If the vertical or lateral assessment is insufficient, Olin is required to submit a plan to adequately characterize the contamination. We are continually reviewing data to ensure the assessment is adequate.*

8. The Perchlorate Community Advisory Group could use some help with staffing, administrative costs, and website hosting
Response *– Regional Board staff will continue to work with Santa Clara Valley Water District staff to support the advisory group. The Regional Board can probably assist with supplies.*

9. If obtained, how should the federal funding currently under consideration be used?
Response *– It is unclear what agency will be responsible for disbursing these funds, but staff will push for community involvement in the decision making.*

10. Provide interim pump and treat at the Olin facility
Response *– Olin plans to comply with our requirement to have a groundwater extraction and treatment system operational at the site by the end of 2003.*

11. Facilitate rapid certification of perchlorate treatment systems for point-of-use and wellhead applications. Consider XT electrolysis systems – no residue
Response *– Regional Board staff has contacted the state Department of Health Services and NSF to better understand the certification process. The Perchlorate Community Advisory Group is meeting with elected officials on September 25 to discuss this issue.*

12. At the source, consider using a downgradient barrier with treated water.
Response *– Olin will evaluate cleanup alternatives for feasibility and will propose a cleanup system.*

13. Share Olin info simultaneously with the agencies and Community Advisory Group

14. Morgan Hill asked for data from Olin, Olin refused to provide it.
Response *– In the instance referred to by Morgan Hill at the Board meeting, Olin did eventually share the data. In general, however, data sharing can definitely be improved. Staff will be working with Olin with the goals of having the agencies receive all Olin submittals at the same time we do and setting up a shared electronic database.*

15. Why not make it a superfund site?
Response *– We could request EPA to evaluate the site for listing on the National Priority List. However, Superfund status does not necessarily mean better or faster cleanup. Superfund status is useful in cases where the responsible party cannot be identified or is unable to fund cleanup. That is not the case in this instance.*

16. Fix delays in data reporting, e.g., Leavesly Road site sampled in April, but just received results.
17. Change reporting frequency from quarterly to monthly to increase speed of data transfer.
Response *– Staff will explore options to improve data reporting and sharing.*

18. Provide a groundwater barrier at the south end of the contaminant plume
Response *– After Olin completes characterization of the plume, we will have a better idea of what wells need protection, and what measures will best protect them.*

19. Need a health risk analysis
Response *– The Community Advisory Group is and will be discussing funding and other obstacles currently impeding a risk assessment.*

20. Wells that tested clean do not get resampled, yet we know the test results bounce around.
Response *– Olin is sampling a representative group of wells quarterly to improve our understanding of concentration variations over time. Olin is also sampling quarterly all wells with previous results showing perchlorate between 2 and 4 ppb. In addition,*

wells tested clean that are close to other wells with perchlorate detections may be eligible for follow-up testing. Residents can call the Regional Board (John Mijares at 805-549-3696) if they have questions about their particular situation.

Regional Board correspondence regarding the Olin site will soon be available on our web site. at the following location: http://www.swrcb.ca.gov/rwqcb3/Facilities/Facility.htm

McCormick Selph, 3601 Union Road, Hollister, San Benito County [John Mijares 805-549-3696]

McCormick Selph, Inc., designs, develops, qualifies, and manufactures state-of-the-art controlled pyrotechnics (electric igniters, electric primers, explosive bolts, gas generators, etc.) for the aerospace and automotive industries. In May 1971, McCormick Selph completed the Hollister facility and started manufacturing operations at the 270-acre site (Attachment 5). In 1993, McCormick Selph, which was then a subsidiary of Teledyne, Inc., was realigned with Ryan Aeronautical and became Teledyne Ryan Aeronautical/McCormick Selph Ordnance. Allegheny Teledyne Incorporated was formed in August 1996 through the business combination of Teledyne, Inc. and Allegheny Ludlum Corporation.

In late 1999, Allegheny Teledyne sold the business and assets of McCormick Selph but retained certain liabilities related to the business, including liability for certain environmental issues at the Hollister facility. Subsequently, as part of a spin-off of two new entities, Allegheny Teledyne changed its name to Allegheny Technologies and Teledyne Industries changed its name to TDY Industries. Consequently, TDY Industries is considered the responsible party for environmental issues at the facility.

Prior to the sale of McCormick Selph, the prospective buyer sampled all existing onsite monitoring wells for various potential contaminants. In June 1999, Teledyne staff informed Regional Board staff that perchlorate and volatile organic compounds (VOCs) had been detected in some monitoring wells.

Over the past ten years, total annual perchlorate use at the facility has averaged approximately 1,800 grams of potassium perchlorate and 300 grams of ammonium perchlorate with the following exceptions: (1) During a two-year period from 1998 through 2000, approximately 500 lbs (226,750 grams) of potassium perchlorate were used annually at the facility and (2) current projected use for 2003 includes approximately 5 lbs (2,260 grams) of ammonium perchlorate. Perchlorate wastes are thermally destructed at the facility.

TDY Industries, through its consultant PES Environmental, has conducted a series of soil and groundwater investigations to determine the source areas and extent of perchlorate and VOCs contamination at the site. These investigations found the geologic units underlying the site can be divided into two units: (1) sedimentary rocks of the Purisima Formation; and (2) recent alluvial deposits.

PES submitted a December 19, 2002 report titled *Corrective Action Plan, Soil and Water Investigation, McCormick Selph, Inc*. for Regional Board review and approval. The report contained information on the results of the October 2002 groundwater monitoring event and proposed corrective action to clean up perchlorate and VOCs in groundwater. Results of groundwater monitoring show that in wells where perchlorate was detected the concentrations range from 19 to 5,500 µg/L. In well IB-28 trichloroethylene (MCL of 5 µg/L) was at 110 µg/L and 1,1-dichloroethylene (MCL of 7 µg/L) was at 13 µg/L. Perchlorate was not detected in either water supply well W-1 or W-2 and the perchlorate plume appears to be contained on the site.

To clean up the perchlorate and VOCs contamination in groundwater, PES evaluated three remedial alternatives: monitored natural attenuation, groundwater extraction and treatment, and enhanced in-situ bioremediation. The criteria used in evaluating the remedial alternatives included effectiveness, feasibility, and cost. PES proposes to use monitored natural attenuation

in areas with relatively low concentrations and limited extent of perchlorate and VOCs.

To clean up the perchlorate plume within the alluvial deposits in the vicinity of the TSU-3/Thermal Destruct Facility, PES proposes to use enhanced in-situ bioremediation because of the relatively elevated levels of perchlorate within this plume and the presence of downgradient water supply wells. This process has been used with success at the Whittaker facility discussed below. Regional Board staff approved the cleanup plan on February 13, 2003. TDY will begin implementation by April 2003.

Three additional monitoring wells were installed on April 28 and 29, 2003. These monitoring wells were installed to monitor perchlorate concentrations along the margins of the perchlorate plume present within the alluvial deposits in the vicinity of the TSU-3/Thermal Destruct Facility area.

PES, on behalf of TDY Industries, submitted on September 4, 2003, an Enhanced In-Situ Bioremediation Pilot Study Workplan. The workplan describes the proposed design, methods and procedures for a pilot-scale enhanced in-situ bioremediation program to assess its effectiveness in remediating perchlorate in groundwater within the shallow alluvial aquifer at a portion of the site. Based on evaluation of several in-situ bioremediation technologies applicable to perchlorate, PES selected the injection of HRC as the preferred technology for the pilot study. A pilot-scale injection of HRC will be performed at the perchlorate plume located within the alluvial deposits in the vicinity of the Thermal Destruct Facility.

HRC is a proprietary, polylactate ester formulated for slow release of lactic acid upon hydration. HRC is typically used to stimulate or enhance reductive dechlorination processes occurring in perchlorate and VOC-contaminated groundwater. HRC is designed to generate anaerobic conditions in the aquifer and promote biomass generation by providing an easily assimilated carbon source via a time-release method. Initially, when in contact with subsurface moisture, HRC slowly releases lactic acid, which is metabolized by indigenous anaerobic microbes producing low concentrations of dissolved hydrogen. The resulting hydrogen is then used by other microbes (reductive dehalogenators) to strip off the chlorine atoms and allow for further biological degradation.

Board staff is currently reviewing the workplan. When approved, PES anticipates starting field activities in fall 2003.

Whittaker Ordnance Facility, 2751 San Juan Road, Hollister, San Benito County [John Mijares 805-549-3696]

The Former Whittaker Ordnance Facility is located on an approximately 94-acre site near Hollister, surrounded by farmland (see Attachment 6). Historical uses of the facility consist of an operating dairy farm prior to 1957 and an ordnance manufacturing facility from 1957 to present. In 1957, the property was acquired by the Holex Company, Inc. and developed to produce small explosives. The property became a division of the Whittaker Corporation in 1980 and was operated as Whittaker Ordnance from 1980 to 1993. Quantic Industries, Inc. obtained the property in 1994 and continued to manufacture explosive devices used for vehicular safety products. In 2001, Pacific Scientific Energetic Materials (operating under PacSci-Quantic) acquired the property from Quantic and continues to manufacture explosive devices used for vehicular safety products.

Groundwater directly beneath and adjacent to the Property occurs in three separate aquifers. The Unit 1 aquifer consists of interbedded silty sands and clayey silts to a maximum depth of approximately 68 feet below ground surface (bgs), the Unit 3 aquifer consists of a second silty sand layer from 40 to 125 feet bgs, and the Unit 4 aquifer consists of a thick coarse sand layer located 160 to 270 ft bgs. The aquifer is encountered between depths of 120 to 160 feet bgs in the Middle Facility. A discontinuous aquitard exists between Unit 1 and 3, which is identified as Unit 2. The presence of groundwater at approximately the same elevation in the Unit 1 and 3 aquifer zones indicates some hydraulic connectivity.

In addition, faulting running southwest to northeast in the vicinity of the Lower Facility may also provide conduits to the deeper Unit 4 aquifer. The lithology encountered in Units 1 to 3 consists of interbedded clayed silts, with the silty sand layers identified as the preferential pathways and water bearing units.

Environmental assessment activities were initiated in 1991 after detections of halogenated volatile organic compounds (HVOCs) in an onsite water supply well. Subsequent investigation activities identified several sources of soil and groundwater pollution throughout the property. Identified constituents of concern include trichloroethylene (TCE) and its breakdown products (e.g., vinyl chloride and 1,2-DCE), Freon 113, perchlorate, and hexavalent chromium. All of these constituents have been detected in soil and groundwater beneath and adjacent to the facility at concentrations above water quality standards. Table 1, below, summarizes relevant water quality data concerning the most significant constituents detected.

Table 1: Maximum Concentration Table

Constituent	Well	Maximum Conc.	MCL/ AL
TCE	MW-7	92,000	5
vinyl chloride	MW-3	3,800	0.5
hexavalent chromium	MW-20	260	50
perchlorate	MW-27	290,000	4 (AL)
Freon 113	MW-30	12,000	1,200

All units are parts per billion (ppb)
MCL – Maximum Contaminant Level
AL – Action Level

There are several likely sources areas at the site. They include areas where perchlorate was stored, milled, and used in manufacturing process. Areas where explosive devices were test fired and burned are also likely sources. Wash water throughout the facility was either disposed of on ground surface in or dry wells.

Two separate perchlorate plumes are found within the Unit 1 aquifer, one near the Building 23 area (Lower Facility) and a second near the south side of the Building 5 area (Middle Facility). Both of these plumes are commingled with the Lower Facility TCE plume. Two more perchlorate plumes are found in perched groundwater within the Middle Facility. The most significant is located directly beneath the Burn Area. The other plume is directly beneath and adjacent to the Building 22A area. The Middle Facility perchlorate plume extends approximately 1,000 feet (northeast to southwest). The Lower Facility perchlorate plumes extend approximately 1,000 feet from the Building 5 area.

Detectable concentrations of dissolved HVOCs and perchlorate are also present in the Unit 3 and Unit 4 aquifers at significant concentrations. Groundwater containing HVOCs and perchlorate may have migrated into these deeper water-bearing units by way of a former water supply well, which was destoryed in May 1996, or in the area north and northwest (downgradient) of the Property where the shallow and deeper water-bearing units may be hydraulically connected. Down gradient to the north, the Riverside Irrigation Company well (screened within the Unit 3 aquifer) has reported TCE concentrations (1,200 ppb) exceeding drinking water standards. Perchlorate concentrations within the Unit 3 and 4 aquifer zones are much lower, but still above the action level of 4 ppb. The TCE plume's circumference within Unit 3 is approximately 1000 feet. TCE concentrations within Unit 4 are primarily restricted to areas near the Riverside and Christopher wells. The perchlorate plume within Unit 3 expands more than 1,000 feet in the northwest direction. Perchlorate detections in the Unit 4 aquifer zone are restricted to detections from the Riverside and Christopher wells, and the Burn Area. Detected contaminants within the Unit 4 aquifer zones are relatively low and significant plumes have not developed. Perchlorate has been detected in five off-site wells (Butler, Sanchez, Dike, Christopher, and Riverside) previously used for domestic or agricultural supply. Impacted wells are either treated before use or are no longer in service.

On July 9, 1999, the Regional Board issued Cleanup or Abatement Order (CAO) No. 99-006 to Whittaker. CAO No. 99-006 specifies cleanup actions that Whittaker must take to address soil and groundwater contamination at the site. A monitoring and reporting program ensures adequate sampling and monitoring of contaminated areas.

Whittaker is implementing several interim soil and groundwater remediation measures at various source areas throughout the facility. Regional Board staff approved a final risk assessment report addressing human health and safety throughout the site. On October 31, 2002, staff approved a final feasibility study report addressing all soil and groundwater remediation alternatives at all identified pollution source sites, including all groundwater plumes within each impacted water-bearing zone.

On March 17, 2003, Whittaker submitted a corrective action plan. (CAP). The CAP contains specific strategies for controlling groundwater plumes and restoring and protecting groundwater quality at seven contaminated source areas: North Building 5 Septic Tank Area, Building 23 Area, Lower Pond Area, Building 22A Area, Burn Area, South Building 5 Drywell Area, and the Waste Storage Pad Area. The proposed groundwater remedial actions were specifically designed to clean up groundwater impacted by HVOCs, perchlorate, and hexavalent chromium. The CAP further included proposed remedial actions for cleaning up perchlorate-impacted soils at five of the seven contaminated areas. Board staff approved the CAP on May 7, 2003, and established timelines for implementation and submittal of compliance reports.

On September 15, 2003, Whittaker submitted a Corrective Action Plan Implementation Report. The report discusses the implementation status of the comprehensive soil and groundwater remediation strategies proposed in the CAP and approved by the Board on May 7, 2003. Whittaker's consultant (Arcadis) uses the In-Situ Reactive Zone™ (IRZ™) Remediation Program for treatment of perchlorate, hexavalent chromium, and HVOCs in groundwater at the site. The IRZ™ technology relies on the delivery of an organic carbon substrate mixture (corn syrup) to the subsurface via batch injections to stimulate microbial activity, thereby creating a reducing environment for in-situ bioremediation. The status of remedial action for each source area is discussed below.

North Building 5 Septic Tank Area (Perchlorate, HVOCs, and hexavalent chromium) *– Operation of an ozone-sparging system, groundwater extraction and treatment system (ion exchange), Riverside well stripper for removal of HVOCs, and private water supply well treatment system for HVOCs will continue until remediation is complete.*

Building 23 Area (Perchlorate, HVOCs, and hexavalent chromium) *– IRZ™ in-situ bioremediation of the Unit 1 aquifer continues. Three additional injection wells were added in July 2003, to the original three injection wells. TDY will evaluate operation of the system and if needed expand and modify treatment system by July 2004.*

Lower Pond Area (Perchlorate, HVOCs, and hexavalent chromium) *– Whittaker started in July 2003 an IRZ™ in-situ bioremediation that included the installation of 20 IRZ/substrate injection wells and two additional monitoring wells along the northwestern property line to contain and remediate the commingled plume emanating from the South Building 5 Drywell Area, the Former Waste Storage Pad Area, and the Lower Pond Area.*

Building 22A Area (Perchlorate) – *Whittaker started in September 2003 an in-situ bioremediation pilot test using ethanol as the carbon source to remediate perchlorate in soil. The pilot test report will be submitted within 60 days of the completion of testing.*

Burn Area (Perchlorate and HVOcs) *– Whittaker started in November 2001 an IRZ™ in-situ anaerobic bioremediation of perched zones lying within 50 feet from grade. Groundwater treatment for the deeper perched zones (85-110 feet bgs) will be selected based on results of pilot testing in other source areas and is anticipated to start by July 2005.*

Northwest Site Boundary Area (Perchlorate, HVOCs, and hexavalent chromium) – *This area was previously included in the South Building 5 Drywell Area. In-situ bioremediation of Unit 1A water-bearing zone is in progress via injection of Hydrogen Release Compound (HRC) slurry. In July 2003, Whittaker installed 20 IRZ™ injection wells and two additional monitoring wells along the northwestern property line to contain and remediate the commingled plume emanating from the South Building 5 Drywell Area, the Former Waste Storage Pad Area, and the Lower Pond Area.*

South Building 5 Drywell Area (Perchlorate) *– Whittaker will initiate by September 2003 a pilot study in soil using in-situ bioremediation using ethanol to be integrated with an expanded in-situ groundwater remediation to mitigate the potential for migration from impacted soils. Remedial excavation to be conducted in the event in-situ bioremediation is not viable based on results of the pilot study. In groundwater, in-situ bioremediation was started in November 2000 using batch injection of hydrogen release compound.*

Waste Storage Pad Area (Perchlorate and HVOCs) – *Whittaker started in July 2003 an in-situ bioremediation that includes installation of 20 IRZ/substrate injection wells and two additional monitoring wells along the northwestern property line to contain and remediate the commingled plume emanating from the South Building 5 Drywell Area, the Former Waste Storage Pad Area, and the Lower Pond Area.*

Whittaker submitted on August 12, 2003, the First Semiannual 2003 Groundwater Monitoring Report. The report will be reviewed by Board staff and the findings and progress of remediation will be provided in the next status report.

ATTACHMENTS:

1. San Martin Area Perchlorate Investigation
2. Regional Board September 30, 2003 letter to Olin
3. Regional Board September 30, 2003 letter to Olin
4. Regional Board September 5, 2003 letter to Olin
5. Site Location Map of the former McCormick Selph Facility
6. Site Map of the former Whittaker Ordnance Facility